



T-64-05

FLJ-UR Series

Single In-line Hybrid

Resistor Tuneable Filter

FEATURES

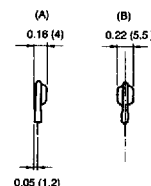
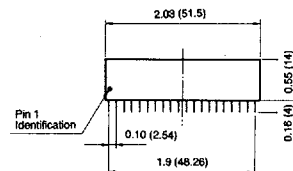
- Small and thin size
- A variety of families
- Cutoff frequency f_c is set by only two or four resistors
- Light weight, low cost

GENERAL DESCRIPTION

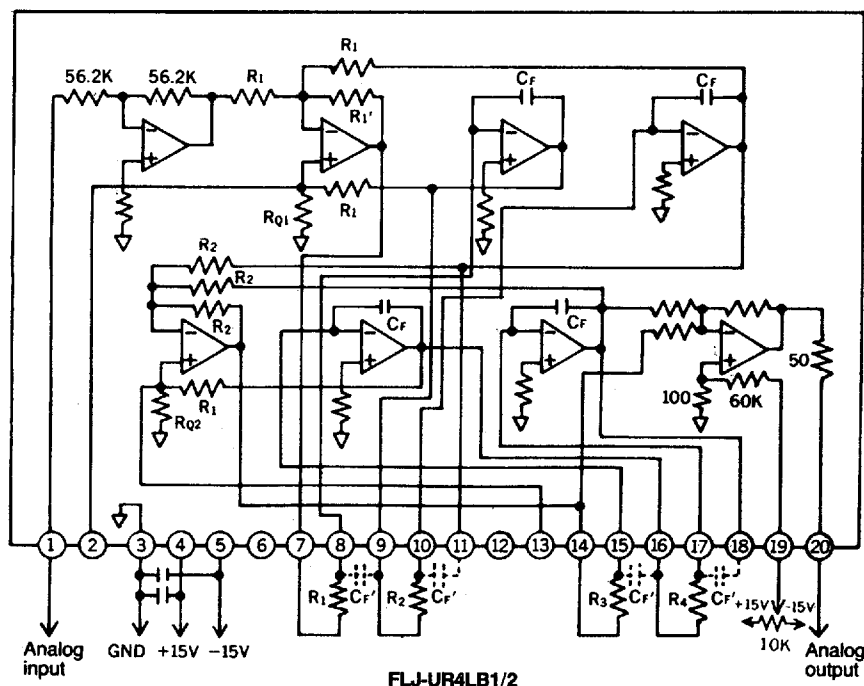
The FLJ-UR series filters are single in-line package resistor tuneable filters. They are small in size and can reduce installation space on the printed circuit board. The cutoff frequency can be easily set by only two or four external resistors. The series has a variety of products, allowing system designers flexibility in selecting filters to suit their application.

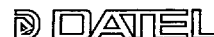
MECHANICAL DIMENSIONS (Fig. 2)

INCHES (mm)



Pin cross section: 0.02x0.01 (0.5x0.25)



FLJ-UR Series**SPECIFICATIONS**

Typical at R=31.8 k Ω , 25°C and $\pm 15V$ supply voltage unless otherwise specified.

COMMON SPECIFICATIONS TO ALL MODELS**ABSOLUTE RATINGS**

Supply voltage ($\pm V_s$) $\pm 18V$
 Input voltage..... $\pm V_s$

FREQUENCY CHARACTERISTICS

f_c accuracy..... $\pm 3\%$ max.
 (with 0 dB gain at the frequency given in Note *2)

INPUT CHARACTERISTICS

Input Impedance.....50 k Ω min.
 Maximum Input Voltage $\pm 10V$

OUTPUT CHARACTERISTICS

Output Impedance100 Ω max.
 Maximum Output Voltage ... $\pm 10V$ min.
 Load Resistance.....10 k Ω min.
 Noise (10~500 kHz).....140 μV max.
 Offset Voltage..... ± 30 mV max. zero adjustable

POWER SUPPLY AND ENVIRONMENTS

Supply Voltage..... $\pm 15V$
 Supply Voltage,
 Operating Range $\pm 5V \sim \pm 18V$
 Operating Temperature/
 Humidity Range-20°C~70°C, 10~95% RH
 Storage Temperature/
 Humidity Range-30°C~80°C, 10~80% RH

SPECIFICATIONS 1 (4 POLE MODELS)

No. of poles/characteristics		4-pole lowpass	4-pole lowpass	4-pole highpass	4-pole highpass
Type		Butterworth	Chebyshev	Butterworth	Chebyshev
Model		FLJ-UR4LA	FLJ-UR4LB	FLJ-UR4HA	FLJ-UR4HB
f _c (-3 dB) characteristics					
Range ^{*1}	Suffix 1 model	40 Hz~1.6 kHz	*Same as left	*Same as left	*Same as left
	Suffix 2 model	400 Hz~20 kHz	.	400 Hz~5 kHz	.
Setting		by 4 external resistors	.	.	.
Pass band characteristics					
Gain ^{*2}		0 dB ± 0.3 dB	.	0 dB ± 1 dB	.
Ripple		—	0.28 dBp-p	—	0.28 dBp-p
Upper-limit frequency (small signal)		—	—	50 kHz ± 1 dB max. ^{*3}	.
Rolloff characteristics					
Rolloff		24 dB/oct	42 dB/oct or equivalent	24 dB/oct	42 dB/oct or equivalent
Attenuation volume (1/2 f _c or 2 f _c)		24 dB	55 dB	24 dB	55 dB
Minimum attenuation		—	46 dB	—	46 dB
Attenuation at 1 MHz		70 dB min.	.	—	—
Output characteristics					
Offset drift		30 $\mu V/^{\circ}C$.	15 $\mu V/^{\circ}C$.
Distortion rate ^{*2}		0.01%	.	0.1%	.
Slew rate		—	—	2V/ μ sec	.
Quiescent current/package					
Quiescent current (@ $\pm 15V$)		± 12 mA	± 16 mA	± 8 mA	± 16 mA
Package		20 pins SIP (A)	.	.	.

SPECIFICATIONS 2 (2 POLE AND 1 POLE PAIR MODELS)

No. of poles/characteristics		2-pole high lowpass	1-pole pair bandpass	2-pole pair bandpass	2-pole pair band elimination
Type		Butterworth	Butterworth	Butterworth	Butterworth
Model		FLJ-UR2LH	FLJ-UR1BA	FLJ-UR2BA	FLJ-UR2EA
f _c (-3 dB) characteristics					
Range ^{*1}	Suffix 1 model	40 Hz~1.6 kHz	*Same as left	*Same as left	*Same as left
	Suffix 2 model	400 Hz~20 kHz	400 Hz~10 kHz	.	.
Setting		by 2 external resistors	.	by 4 external resistors	.
Pass band characteristics					
Gain ^{*2}		0 dB ± 0.3 dB	0 dB ± 1 dB	.	0 dB ± 0.3 dB
Upper-limit frequency (small signal) ^{*3}		100 kHz ± 1 dB HPF	—	—	50 kHz ± 1 dB max.
Rolloff characteristics					
Rolloff		12 dB/oct	—	—	—
Q		—	5 ^{*4}	5	5
Attenuation volume (1/2 f _c or 2 f _c)		12 dB	17.5 dB	35 dB	—
Attenuation at 1 MHz		-70 dB min. LPF	.	.	—
Maximum attenuation (f ₀)		—	—	—	60 dB
Output characteristics					
Offset drift		15 $\mu V/^{\circ}C$.	.	30 $\mu V/^{\circ}C$
Distortion rate ^{*2}		0.1%	0.01%	.	.
Slew rate		2V/ μ sec HPF	—	—	2V/ μ sec
Quiescent current/package					
Quiescent current (@ $\pm 15V$)		± 8 mA	.	± 12 mA	± 20 mA
Package		20 pins SIP (A)	.	.	20 pins SIP (B)

*1: Addition of 2 or 4 external capacitors allow extension to lower band.

*2: FLJ-UR4LA, 4LB; f_c/10. FLJ-UR4HA; 3.3 f_c. FLJ-UR4HB; 10 f_c (f_c≤3 kHz), 3.3 f_c (f_c>3 kHz)
 FLJ-UR2LH; f_c/10 (LPF), 10 f_c (HPF)

*3: Gain of 0 dB at above stated frequencies. (See *2)

*4: Connection of a specified pin to GND allow 10, 20, 30, 40 and 50. External resistors allow a range of 1.81≤Q≤50

TECHNICAL NOTES

1. Do not use a switching regulator. Use a well regulated $\pm 15V$ power supply. Install $0.01 \mu F$ bypass capacitors as close to the filter as possible.
2. Use metal film resistors of 1% tolerance for f_c setting. When making a higher-order filter, use more accurate resistors.
3. Connect external resistors with short leads as close to the filter as possible.
4. Use external capacitors with good stability and high dielectric resistance. It is recommended to use multilayer ceramic capacitors or plastic film capacitors.
5. Regulate output offset voltage by using an external trimmer ($10 K\Omega$ to $50 K\Omega$).
6. The FLJ-UR series filters are packaged single inline and are compact in size. Installation at high-density may cause temperature rises between elements. Installation with $0.8"$ or more of space between filters can eliminate the problem.
7. Relation between f_c and external resistor/capacitor:
With the FLJ-UR series, a cutoff or center frequency can be set by 2 or 4 external resistors. The values of R of 2 or 4 external resistors for normal use can be calculated as;

$$R = \frac{15.9 \times 10^6}{f_c (\text{Hz})} (\Omega) \quad \text{Suffix 1 model}$$

$$R = \frac{159 \times 10^6}{f_c (\text{Hz})} (\Omega) \quad \text{Suffix 2 model}$$

Note: $R_1 = R_2 = R_3 = R_4$

In certain applications the resistance of each of 2 or 4 resistors may be changed. R_1 to R_4 shown in the block diagrams are the external resistors explained here. In standard use, the f_c can be set to a minimum of 40 Hz. This is because the values of R have to be increased to about 400K according to the relation between R and f_c . The f_c setting range can be expanded to lower band by adding 2 or 4 external capacitors.

$$R = \frac{159 \times 10^3}{(C_{ext} + 0.01) f_c} (\Omega) \quad \text{Suffix 1 model}$$

$$R = \frac{159 \times 10^3}{(C_{ext} + 0.001) f_c} (\Omega) \quad \text{Suffix 2 model.}$$

where C_{ext} is measured in μF and f_c in Hz.

In the applications in which the output offset, time drift, or output noise must be minimal, use the above external capacitors if the values of external resistors exceed 100 k Ω each.

8. How to tune f_c

As shown in the specifications, the f_c setting accuracy is 3% depending on the accuracy of elements used. There is no practical problem in tuning when they are used as low-pass or highpass filters. However, bandpass filters and band elimination filters may require sharp tuning. Such filters can be tuned with external trimmers as shown in Fig. 10. R_1 , R_2 and VR_1 are not used with the FLJ-UR1BA1/2.

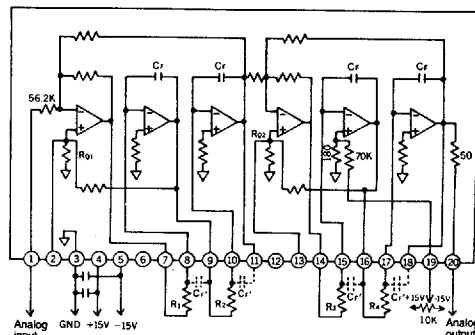
a. FLJ-UR1BA1/2

- An input signal of oscillating frequency f_c is given.
- I/O signals are monitored with a phase measuring instrument such as an oscilloscope.
- Tune VR_2 until the phase difference between I/O signals can be reduced to 0° .

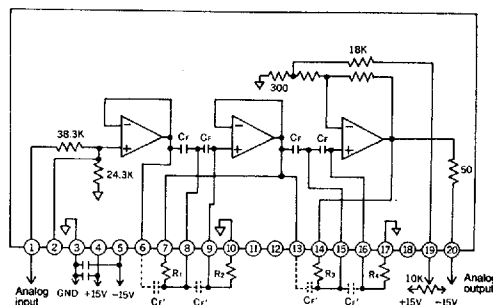
b. FLJ-UR2BA1/2

- An input frequency of $1.0734 \times f_c$ is provided.
- Tune VR_1 until the phase difference between the input signal and the output signal at pin 9 reaches at 180° looking at a phase measuring instrument such as an oscilloscope.
- An input signal of frequency f_c is given.
- Tune VR_2 until the phase difference between the input signal and the output signal at pin 20 is set at 0° .

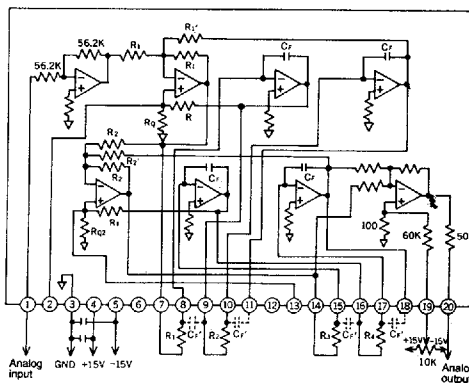
FLJ-UR4LA1/2 Block Diagram (Fig. 3)



FLJ-UR4HA1/2 Block Diagram (Fig. 4)

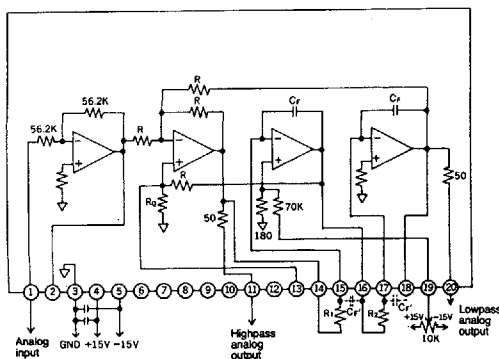


FLJ-UR4HB1/2 Block Diagram (Fig. 5)

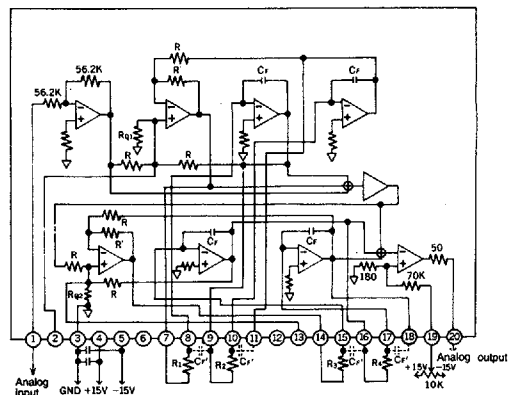


C_f in each figure is 10000 pF for suffix 1 model and 1000 pF for suffix 2 model.

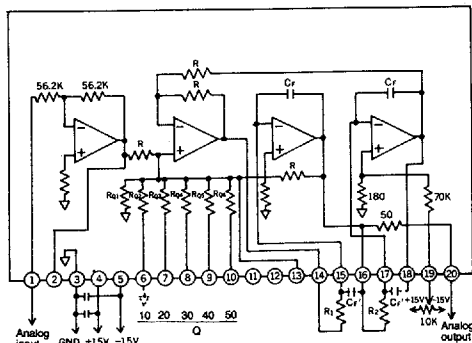
FLJ-UR2LH1/2 Block Diagram (Fig. 6)



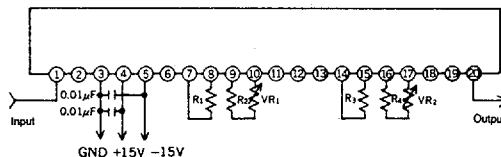
FLJ-UR2EA1/2 Block Diagram (Fig. 9)



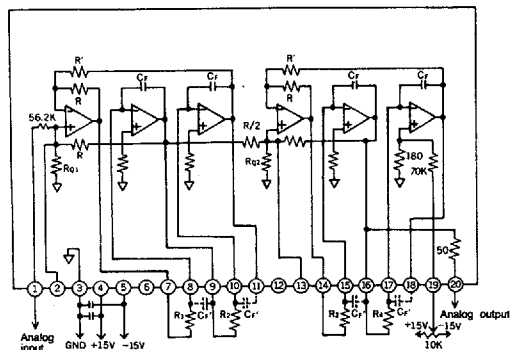
FLJ-UR1BA1/2 Block Diagram (Fig. 7)



fc tuning method (Fig. 10)



FLJ-UR2BA1/2 Block Diagram (Fig. 8)



Cf in each figure is 10000 pF for suffix 1 model and 1000 pF for suffix 2 model.

ORDERING INFORMATION

LOW CUTOFF FREQUENCY TYPE (40 Hz~1.6 kHz)

FLJ-UR4LA1: 4-pole lowpass, Butterworth
 FLJ-UR4LB1: 4-pole lowpass, Chebyshev
 FLJ-UR4HA1: 4-pole highpass, Butterworth
 FLJ-UR4HB1: 4-pole highpass, Chebyshev
 FLJ-UR2LH1: 2-pole lowpass/highpass, Butterworth
 FLJ-UR1BA1: 1-pole pair bandpass, Butterworth
 FLJ-UR2BA1: 2-pole pair bandpass, Butterworth
 FLJ-UR2EA1: 2-pole pair band elimination, Butterworth

HIGH CUTOFF FREQUENCY TYPE (400 Hz~5 k/10 k/20 kHz)

FLJ-UR4LA2: 4-pole lowpass, Butterworth
 FLJ-UR4LB2: 4-pole lowpass, Chebyshev
 FLJ-UR4HA2: 4-pole highpass, Butterworth
 FLJ-UR4HB2: 4-pole highpass, Chebyshev
 FLJ-UR2LH2: 2-pole highpass/lowpass, Butterworth
 FLJ-UR1BA2: 1-pole pair bandpass, Butterworth
 FLJ-UR2BA2: 2-pole pair bandpass, Butterworth
 FLJ-UR2EA2: 2-pole pair band elimination, Butterworth